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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS MADE DURING MARCH, 1929

By HERBERT H. KIMBALL

For references to descriptions of instruments and exposures, and to an account of the method of obtaining and reducing the measurements, the reader is referred to this volume of the REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged above normal values for March at Washington and below normal values at Madison and Lincoln.

Table 2 shows an excess in the total radiation received on a horizontal surface at Chicago, and a deficiency at Washington, Madison, and Lincoln.

Skylight polarization measurements obtained on five days at Washington give a mean of 62 per cent with a maximum of 68 per cent on the 29th. These are above the corresponding averages for March at Washington. At Madison measurements obtained on the 28th gave 73 for the percentage of skylight polarization, which is considerably above the average for that station in March.

TABLE 1.—Solar radiation intensities during March, 1929

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance										Local mean solar time	
	S a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°		Noon
	75th mer. time	Air mass										
		A. M.					P. M.					
e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.		
Mar. 1	4.17				1.02						3.45	
Mar. 3	3.15				1.28	1.55	1.27	1.07	0.86	0.72	3.00	
Mar. 6	2.62	0.87	0.93	1.15	1.35		1.17				2.87	
Mar. 7	1.52	0.98	1.08	1.20	1.34	1.49					2.06	
Mar. 8	1.37	0.69	0.85	1.01	1.13	1.30					1.60	
Mar. 11	2.36						1.41	1.10	1.00	0.85	2.87	
Mar. 16	7.87			1.05	1.25						6.27	
Mar. 18	2.87	0.87	0.92	1.07	1.19	1.45	1.26	0.98	0.88	0.77	2.87	
Mar. 24	9.87					1.19					11.81	
Mar. 26	12.68				0.95						10.59	
Mar. 27	4.57		0.88	0.99	1.19	1.44					4.17	
Mar. 29	3.45			1.18	1.38	1.47					2.62	
Means		0.85	0.93	1.09	1.21	1.41	1.28	1.05	0.91	0.78		
Departures		+0.12	+0.12	+0.14	+0.06	-0.02	+0.15	+0.11	+0.11	+0.08		

Madison, Wis.

Mar. 5	1.96	0.87	0.94	1.07	1.27	1.53					2.74
Mar. 7	0.91		1.10	1.25	1.41	1.59	1.41				1.45
Mar. 9	1.07			1.28	1.42	1.57	1.42				1.19
Mar. 14	5.79						1.13				7.87
Mar. 18	4.57		0.88	0.97	1.11		1.16				4.57
Mar. 26	3.63				1.15	1.46					3.30
Mar. 27	4.39						1.06				3.45
Mar. 28	4.17	0.96	1.07	1.19	1.33	1.55	1.26				3.00
Means		(0.92)	1.00	1.15	1.28	1.54	1.24				
Departures		-0.06	-0.04	-0.03	-0.03	-0.05					

Lincoln, Nebr.

Mar. 5	3.63			1.10							4.75
Mar. 6	4.17		0.86	0.96	1.25						3.45
Mar. 7	2.62	0.86	1.01	1.16	1.25						2.87
Mar. 13	4.37			1.00	1.16	1.37	1.27	1.05	0.90	0.75	3.81
Mar. 14	3.63	0.58	0.71	0.99	1.14						4.17
Mar. 16	4.17		1.00	1.15	1.31	1.49		1.11	1.01	0.92	4.37
Mar. 17	3.81						1.25	1.11	0.94	0.84	4.17
Mar. 19	4.17				1.40						3.30
Mar. 26	3.45						1.21	1.08	0.75	0.56	2.36
Means		(0.72)	0.90	1.06	1.25	(1.43)	1.24	1.09	0.90	0.77	
Departures		-0.13	-0.05	-0.03	-0.04		0.04	+0.00	-0.04	-0.05	

1 Extrapolated.

TABLE 2.—Total solar radiation (direct+diffuse) received on a horizontal surface

[Gram-calories per square centimeter]

Week beginning—	Average daily radiation						Average daily departure from normal					
	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Fresno	Washington	Madison	Lincoln	Chicago	New York
1929	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Feb. 26	166	216	291	190	-----	-----	428	-121	-70	-53	+1	-----
Mar. 5	414	307	396	259	-----	-----	329	+94	+13	+43	+63	-----
Mar. 12	277	294	356	230	-----	-----	388	-49	-28	-18	+22	-----
Mar. 19	313	262	349	194	-----	-----	459	-44	-125	-57	-28	-----
Mar. 26	348	399	352	200	-----	-----	563	-2	+36	-51	+24	-----
Excess or deficiency since first of year on Apr. 2								+91	-1,015	-2,828	+973	-----

POSITIONS AND AREAS OF SUN SPOTS

Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson Observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longitude	Latitude	Spot	Group	
1929							
		<i>h. m.</i>	<i>°</i>	<i>°</i>			
Mar. 1 (Naval Observatory)	11 50	-83.5	129.4	-10.0	247	15	-----
		-6.0	206.9	-10.0			-----
		+7.0	219.9	-8.5	93	106	-----
		+26.0	238.9	+7.0			-----
		+33.5	246.4	-14.5	9		472
Mar. 2 (Yerkes)	12 36	-80.3	119.0	-8.8		100	-----
		-74.4	124.9	-7.2		250	-----
		-69.4	129.9	-9.7		100	-----
		+20.8	220.1	-9.7		75	525
Mar. 3 (Naval Observatory)	11 41	-64.0	122.6	-7.5		525	-----
		-56.5	130.1	-10.0	154		-----
		+34.5	221.1	-8.5	31		-----
		+35.5	222.1	+15.0		46	-----
		+51.0	237.6	+7.5		108	864
Mar. 4 (Harvard)	10 43	-77.5	96.5	-9.0		550	-----
		-47.0	127.0	-8.0		673	-----
		+48.5	222.5	-9.5	24		-----
		+51.5	225.5	+15.5		78	-----
		+66.0	240.0	+7.0		80	1,406
Mar. 5 (Yerkes)	10 2	-78.0	83.2	-10.2		400	-----
		-72.7	88.5	-8.1		75	-----
		-67.8	93.4	-10.1		600	-----
		-67.7	93.5	-7.8		150	-----
		-43.5	117.7	-8.1		50	-----
		-35.7	125.5	-7.1		300	-----
		-31.5	129.7	-9.9		60	-----
		+64.4	225.6	+15.4		100	1,736
Mar. 6 (Naval Observatory)	11 59	-62.0	84.9	-3.5	31		-----
		-56.5	90.4	-10.0		648	-----
		-23.0	123.9	-7.0		309	-----
		-17.5	129.4	-10.0		77	-----
		-9.5	137.4	-15.5		31	-----
		+73.5	220.4	-8.5	6		-----
		+78.0	224.9	+16.0		139	1,241
Mar. 7 (Naval Observatory)	11 57	-78.5	55.3	+7.5	93		-----
		-42.5	91.3	-9.5		756	-----
		-9.0	124.8	-7.0		278	-----
		-5.5	128.3	-10.5		77	-----
		+3.5	137.3	-15.5		25	-----
		+44.5	178.3	+15.5		46	1,276
Mar. 8 (Naval Observatory)	11 38	-66.0	54.8	+7.5	62		-----
		-28.0	92.8	-9.5		766	-----
		+5.0	125.8	-7.0		401	-----
		+19.0	139.8	-15.5	12		-----
		+60.5	181.3	+15.5	46		1,277
Mar. 9 (Naval Observatory)	12 26	-62.5	44.7	+23.0		77	-----
		-52.5	54.7	+7.5		46	-----
		-13.5	93.7	-9.0		648	-----
		+19.0	126.2	-8.5		401	1,172
Mar. 10 (Naval Observatory)	11 47	-62.0	32.3	-7.0		93	-----
		-50.5	43.8	+23.0		62	-----
		-39.5	54.8	+7.5	31		-----
		-0.5	93.8	-9.0		679	-----
		+32.0	126.3	-8.0		355	1,220

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longitude	Latitude	Spot	Group	
1929							
Mar. 11 (Naval Observatory).	11 42	° -58.0 -60.0 -37.5 -26.0 +12.5 +45.0	° 23.2 31.2 43.7 55.2 93.7 126.2	° -13.5 -7.5 +22.5 +7.0 -9.0 -7.5	22	170 46 25 802 262	1,327
Mar. 12 (Naval Observatory).	11 55	° -44.5 -35.5 -25.0 -12.5 +25.5 +27.0 +59.0	° 23.4 32.4 42.0 55.4 93.4 94.9 126.9	° -13.5 -7.0 +23.5 +7.0 -9.0 +17.5 -7.5	12	201 77 9 802 6 247	1,354
Mar. 13 (Harvard)-----	13 9	° -28.0 -18.5 +42.0 +74.5	° 26.0 35.5 96.0 128.5	° -14.0 -7.0 -8.0 -6.0	17	159 1,043 310	1,529
Mar. 14 (Yerkes)-----	10 25	° -14.5 -2.8 +52.3	° 27.8 39.5 94.6	° -7.5 -8.3 -9.6		50 50 800	900
Mar. 15 (Mount Wilson).	11 20	° -80.0 -7.0 +23.0 +42.0 +66.0	° 308.7 35.7 51.7 70.7 94.7	° +8.0 -8.0 +7.0 -14.0 -9.0	355	60 3 28 984	1,430
Mar. 16 (Naval Observatory).	11 46	° -70.5 -7.5 +21.0 +37.5 +55.5 +80.5	° 304.8 22.8 36.3 52.8 70.8 95.8	° +9.5 -15.0 -7.5 +7.5 -13.5 -9.0	6	31 15 93 540	1,117
Mar. 17 (Naval Observatory).	11 39	° -57.0 +69.0	° 305.2 71.2	° +9.5 -14.0		417 93	510
Mar. 18 (Naval Observatory).	11 43	° -43.0 +80.0	° 305.9 68.9	° +9.5 -15.0	46	309	355
Mar. 19 (Naval Observatory).	12 41	° -27.0	° 308.2	° +9.5		293	293
Mar. 20 (Naval Observatory).	11 28	° -13.5	° 309.2	° +9.5		293	293
Mar. 21 (Naval Observatory).	11 45	° +0.5	° 309.9	° +9.0		247	247
Mar. 22 (Harvard)-----	10 50	° +15.0	° 312.0	° +8.0	394		394
Mar. 23 (Yerkes)-----	9 47	° +26.6	° 310.7	° +7.8		300	300
Mar. 24 (Naval Observatory).	11 12	° -53.5 +40.5	° 216.6 310.6	° -12.5 +9.0		123 170	293
Mar. 25 (Naval Observatory).	14 25	° -38.0 +56.5	° 217.2 311.7	° -12.5 +8.5		139 170	309
Mar. 26 (Naval Observatory).	11 5	° -26.5 -1.0 +68.0	° 217.3 242.8 311.8	° -12.5 -5.5 +8.5		6 185	361

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longitude	Latitude	Spot	Group	
1929—Continued							
Mar. 27 (Naval Observatory).	11 32	° -12.0 +11.0 +82.0	° 218.4 241.4 312.4	° -12.5 -5.0 +8.5		170 37 170	377
Mar. 28 (Naval Observatory).	11 55	° +2.0	° 219.0	° -12.5			201
Mar. 29 (Naval Observatory).	11 45	° +16.5	° 220.4	° -12.5			185
Mar. 30 (Yerkes)-----	9 20	° +23.6 +26.7 +28.9	° 215.7 218.8 221.0	° +9.9 +9.8 -13.4		75 100 75	250
Mar. 31 (Harvard)-----	12 20	° -79.5 -54.5 +42.0 +45.0	° 97.5 122.5 219.0 222.0	° -10.5 -3.0 +10.5 -13.5		472 52 231 90	845
Mean daily area for March.....							776

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR MARCH, 1929

[Data furnished through the courtesy of Prof. W. Brunner, University of Zurich, Switzerland]

March, 1929	Relative numbers	March, 1929	Relative numbers	March, 1929	Relative numbers
1	44	11	E ²³ 92	21	11
2	47	12	94	22	
3	W ³ 59	13	77	23	E ³ ?
4		14	66	24	
5	53	15	W ¹⁴³ 65	25	22
6	73	16	58	26	35
7	74	17	40	27	39
8	90	18	24	28	18
9	103	19	19	29	W ⁴ 20
10	91	20	15	30	40
				31	55

Mean, 27 days: 52.7.

- ¹ Passage of an average-sized group through the central meridian.
- ² Passage of a large group through the central meridian.
- ³ New formation of a larger or average-sized center of activity; E, on the eastern part of the sun's disk; W, on the western part; M, in the central zone.
- ⁴ Entrance of a larger group on the east limb.

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Beginning this month certain intermediate levels are omitted from Tables 1 and 2 and the wind resultants shown in Table 2 are based on pilot-balloon instead of kite observations. The number of stations shown in this table has been increased.

Table 1 shows a rather striking temperature relationship for the month in that the departures are all positive in the lower levels and negative in the upper levels, the latter increasing appreciably at the highest level, 4,000 meters. In view of this abnormally cold air aloft surmounting abnormally warm air it might be expected that conditions were exceptionally favorable for precipitation. However, with the negative relative humidity departures

occurring coincidentally with negative temperature departures there was no appreciable excess in the monthly precipitation except at Due West, where the total was 10.94 inches. At this station however, the negative temperature departures were smallest.

Vapor pressure departures were positive in the lowest levels and negative above.

Resultant winds for the month were light and variable at the surface and lower levels (see Table 2). At 1,000 meters the directions were mostly westerly and the velocities about 5 m. p. s. At 4,000 meters, the westerly component is pronounced and the velocities range mostly between 10 and 15 m. p. s.